Coronary Artery Angiography Using Multislice Computed Tomography Images

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Multislice CT scanners are the newest class of CT scanners and they have not one but many detectors. These scanners can acquire up to 4 slices of data from the body in the same time it takes a single-slice CT scanner to acquire one. Multislice CT allows for rapid cardiac imaging during a single breath-hold. A multislice scanner operated in helical mode provides information that can be used to reconstruct 3D cardiac images in arbitrary phases of the cardiac cycle.

A 71-year-old man with hypertension, hypercholesterolemia, and known aortic and peripheral vascular disease was imaged with a LightSpeed 4-slice, multislice CT scanner (GE Medical Systems). Ten minutes before the cardiac scan, the patient received intravenous contrast material (150 mL of 300 mgI/mL) for a CT study of his abdomen. The cardiac scan was acquired during a 35-s breath-hold, and simultaneous acquisition of the ECG enabled reconstruction using retrospective gating (Figure 1). The helical pitch was 0.85 (relative to the detector elements), with a 2.5-mm nominal slice thickness (interpolated to 0.625 mm). The interpolated volume elements (voxels) were 0.39×0.39×0.625 mm in a 512×512×130 data matrix covering a 200×200×81 mm volume. The effective temporal acquisition window was 160 ms. Postprocessing tools were used to separate the coronary arteries from the cardiac chamber blood pool. Three-dimensional images can be displayed as projections similar to those obtained at catheter angiography (Figure 2).

These first results of ECG-gated multislice CT cardiac imaging are encouraging. At present, the quality of these scans is dependent on heart rate, rhythm, and patient ability to suspend respiration. Current developments will make this technique more robust. Increasing the number of detector rows will result in improved temporal and spatial resolution and fewer motion artifacts. Faster and variable gantry rotation speeds will improve temporal resolution and image quality over a greater range of heart rates and rhythms. A cardiac gated-pulse x-ray tube could be used to decrease patient dose if diastolic imaging is sufficient. Imaging of the coronary arteries, for example, can be limited to diastole without a diagnostic penalty. A clinical study comparing multislice CT coronary angiography with conventional x-ray angiography is required for validation of this new method.

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Figure 1. A, Transverse CT section shows calcification in right coronary artery (RCA). B, Calcification also exists at edge of 2 aortic valve leaflets. C, Images were reformatted to give a longitudinal view that shows both the cross-section of the calcified right coronary artery and the circumflex branch of the left coronary artery (Cx). D, Short-axis view was reformatted to show left and right ventricles (LV and RV) at end-diastole. E, A 3-mm-thick maximum intensity projection shows right coronary artery calcification. F, A 15-mm-thick projection clearly shows left anterior descending coronary artery (LAD). Ao indicates aorta.

Figure 2. A, Left anterior oblique view surface rendering shows left anterior descending coronary artery (LAD), 2 diagonal branches (Diag), and the circumflex artery (Cx). B, The 3D multi-slice CT images were processed with a computer workstation to both remove the blood pool and create a projection through the coronary arteries. C, The 3D surface image is magnified to examine the coronary arteries. D, A 5-mm-thick projection through this region is made in an oblique plane tangent to the 3D surface model.
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